

AMENDMENTS TO THE CLAIMS

- 5 Claim 1 (Currently amended) An extrusion-free wet cleaning process for post-etch Cu-dual damascene structures, the process comprising:
- providing a wafer comprising a silicon substrate and at least one post-etch Cu-dual damascene structure, the post-etch Cu-dual damascene structure having a via structure exposing a portion of a Cu wiring line electrically connected with an N^+ diffusion region of the silicon substrate and a trench structure formed on the
- 10 via structure;
- executing an oxidation step by applying a diluted H_2O_2 solution to the wafer to slightly oxidize the surface of the exposed Cu wiring line; and
- washing away cupric oxide generated in the oxidation step by means of a cupric oxide cleaning solution containing diluted HF, NH_4F or NH_2OH having a pH of
- 15 above 7, ~~and~~
- ~~preventing Cu reduction reactions on the N^+ diffusion region connected Cu wiring line.~~
- 20 Claim 2 (Original) The process of claim 1 wherein the Cu wiring line electrically connected with an N^+ diffusion region of the silicon substrate serves as a cathode in the cupric oxide cleaning solution.
- Claim 3 (Original) The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises purging inert gas onto the wafer during
- 25 the application to the wafer of the diluted H_2O_2 solution.
- Claim 4 (Original) The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises adding a Cu corrosion inhibitor to the
- 30 diluted H_2O_2 solution.
- Claim 5 (Original) The process of claim 4 wherein the Cu corrosion inhibitor comprises benzotriazole (BTA).
- 35 Claim 6 (Currently amended) The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises reducing the H_2O_2 concentration of the diluted H_2O_2 solution to below 100:1 (v/v) of solvent to H_2O_2 .
- 40 Claim 7 (Original) The process of claim 1 wherein the method of preventing Cu reduction reactions on the Cu wiring line comprises lowering the temperature of the diluted H_2O_2 solution to below $15^\circ C$ during the application to the wafer of the diluted H_2O_2 solution.
- Claim 8 (Cancelled)

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- Claim 9 (Currently amended) A wet cleaning process comprising:
an oxidation step comprising a means for reducing Cu deposition on a cathode-like copper wiring line of a Cu-dual damascene structure, wherein the means for reducing Cu deposition on a cathode-like copper wiring line comprises a step of purging an inert gas during the oxidation process; and
an oxide etch step for washing away cupric oxide generated in the oxidation step by means of a cupric oxide cleaning solution; ~~and~~
~~reducing Cu deposition on a cathode-like copper wiring line of a Cu dual damascene structure.~~
- Claim 10 (Original) The process of claim 9 wherein the oxidation step is used to slightly oxidize a surface of a Cu wiring line in a dual damascene structure by utilizing a diluted H₂O₂ solution.
- Claim 11 (Original) The process of claim 9 wherein the cupric oxide cleaning solution comprises diluted HF, NH₄F, NH₂OH, or diluted HF/HCl.
- Claim 12 (Original) The process of claim 9 wherein the oxide generated in the oxidation step comprises CuO_x and Cu(OH)₂.
- Claim 13 (Original) The process of claim 9 wherein the cathode-like copper wiring line is electrically connected with an N⁺ diffusion region of a silicon substrate.
- Claim 14 (Cancelled)
- Claim 15 (Original) The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises adding a Cu corrosion inhibitor to the diluted H₂O₂ solution.
- Claim 16 (Original) The process of claim 15 wherein the Cu corrosion inhibitor comprises benzotriazole (BTA).
- Claim 17 (Currently amended) The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises reducing the H₂O₂ concentration of the diluted H₂O₂ solution to below 100:1 (v/v) of solvent to H₂O₂.
- Claim 18 (Original) The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises lowering the temperature of the diluted H₂O₂ solution during the oxidation step to below 15°C.
- Claim 19 (Original) The process of claim 9 wherein the process of reducing Cu deposition on a cathode-like copper wiring line comprises increasing the pH of the cupric oxide cleaning solution to above 7.